Section A.

Technical Notes

Scope of the Survey

Data for the National Science Foundation's (NSF's) fiscal year (FY) 1997 report on research and development (R&D) expenditures were collected from 493 institutions of higher education in the United States and Outlying Areas. These institutions were selected from the universe of 674 schools that have doctoral programs in science and engineering (S&E), are historically black colleges or universities that expend any amount of separately budgeted R&D in S&E, or are other institutions that expend at least $50,000 in separately budgeted R&D in S&E.

In addition, the survey includes 18 federally funded research and development centers (FFRDCs). To qualify, an FFRDC must be engaged in basic or applied research, development, or management of R&D activities, and the results of these activities must be directly monitored by the Federal Government—usually a single agency—in a relationship expected to be maintained on a long-term basis. The center must be operated, managed, and administered by either a university or consortium of universities as an autonomous organization or as an identifiable separate operating unit of its parent institution. Finally, 70 percent or more of the center's financial support must be received from the Federal Government.

Although the same survey form (NSF Form 411) is used to collect data from both academic institutions and FFRDCs, the resulting data are presented separately in this report. The survey population was reviewed prior to mailing the questionnaires to ensure that each institutional classification was accurate. Characteristics of the schools were reviewed before and during the course of the survey to determine if changes had occurred (i.e., in highest degree granted or in terms of school openings, closings, or mergers).

Survey Instrument

Most major R&D performers have incorporated into their recordkeeping systems the data that are essential to complete this survey, thereby ensuring a consistent format from one year to the next. Such consistency yields the most useful statistics for time series. As a rule, information to complete this questionnaire is found within the institutions' year-end accounting records.

The survey questionnaire consists of four main items:

Item 1 is a request that institutions report their total current expenditures for separately budgeted science and engineering R&D for all activities specifically organized to produce research outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit, i.e., research centers, within the institution by source of funds. In addition, schools are asked to provide the percentage of the total and the percentage of the federally financed expenditures that are considered basic research. Included also are research funds for which an outside organization, educational or other, is a subrecipient. Care should be observed when interpreting data on source of funds; for example, industry R&D support is limited to grants and contracts for R&D activities from profit-making organizations. Total industry funds excludes research funded through unrestricted accounts and from corporate foundations, endowments, and fellowships to students; those funds would be included in institutional own funding totals. An increasing number of institutions have linkages with industry and foundations via subcontracts, thus complicating the identification of funding source. In addition, institutional policy may determine whether unrestricted State support is reported as State or as institutional funding.

Item 1A, added in FY 1996, is a request for total and federally financed current fund expenditures for separately budgeted science and engineering R&D passed through the institution to subrecipients. Schools were asked to break out the subrecipient category by "educational" and "other."

Item 2 is a request for total and federally financed current fund expenditures for separately budgeted R&D activities by detailed S&E fields. Major fields remain unchanged from the FY 1994 questionnaire. In the FY 1997 questionnaire, a subfield of bioengineering/biomedical engineering was added under Engineering. When interpreting these data at the detailed discipline level, users should keep in mind that there is considerable interdisciplinary and multidisciplinary activity.

Item 3 is a request for the portions of total and federally financed expenditures reported in items 1 and 2 that were used for the purchase of research equipment out of current funds. This portion includes all research equipment

purchased under sponsored research project awards and disbursed in the same detailed disciplines as in item 2. These data are of special interest to Federal and institutional policymakers in determining current funding levels for scientific research instrumentation.

ITEM 1A ANALYSIS

Because the responses to this item are not published in any of the Detailed Statistical Tables, a summary is presented here and in the following tables. This item was completed by 87 percent of the respondents. The total R&D expenditures passed through to subrecipients, $760 million, represented 4.3 percent of the item 1A respondents' total R&D expenditures and 3.2 percent of all separately budgeted R&D in FY 1997 (table 1). The doctorate-granting institutions reported a higher percentage of pass-through funds than the non-doctorate-granting institutions. Item 1A respondents from doctorate-granting institutions reported $754 million, or 4.3 percent, of their total R&D expenditures were passed through to subrecipients, versus $6.7 million or 2.5 percent of item 1A non-doctorate-granting respondents. Item 1A respondents from public institutions reported a higher percentage (4.8 percent) of pass-through funds than those from private institutions (3.4 percent).

Respondents to this question reported $575 million in Federal R&D funds passed through to subrecipients. This amount represented 5.6 percent of the Federal support reported by item 1A respondents and 4.0 percent of the $14.3 billion in total Federal support (table 2).

Table 1. FY 1997 Item 1A Summary for Total Academic R&D Expenditures

(Dollars in Thousands)

Degree and Control	All Respondents Survey R&D 1/	Item 1A 2/ Respondents' Total R&D	Total R&D Expenditures by Subrecipients		
			Educational	Other	Total 3/
All institutions	23,973,176	17,740,304	481,011	174,988	760,429
Doctorate	23,674,426	17,470,182	478,791	173,024	753,765
Non-doctorate	298,750	270,122	2,220	1,964	6,664
Public	16,084,560	11,773,553	406,328	105,085	560,081
Private	7,888,616	5,966,751	74,683	69,903	200,348

1/ This total is the amount prior to both imputation for non-respondents and weighting for universities and colleges not in the survey universe.

2/ Item 1A measures the amount of R&D Expenditures passed through the institution to subrecipients.

3/ Some respondents could not break total down into sectors.

Table 2. FY 1997 Item 1A Summary for Federal Academic R&D Expenditures

(Dollars in Thousands)

Degree and Control	All Respondents Survey R&D 1/	Item 1A 2/ Respondents' Federal R&D	Federal R&D Expenditures by Subrecipients		
			Educational	Other	Total 3/
All institutions	14,321,092	10,311,773	338,171	150,608	575,469
Doctorate	14,120,400	10,130,960	335,951	150,608	570,769
Non-doctorate	200,692	180,813	2,220	---	4,700
Public	8,609,596	6,109,146	273,106	94,149	405,311
Private	5,711,496	4,202,627	65,065	56,459	170,158

1/ This total is the amount prior to both imputation for non-respondents and weighting for universities and colleges not in the survey universe.

2/ Item 1A measures the amount of R&D expenditures passed through the institution to subrecipients.

3/ Some respondents could not break total down into sectors.

Response Rate

The FY 1997 survey questionnaires were mailed in November 1997. Every effort was made to maintain close contact with respondents in order to preserve both consistency and continuity in the resultant data. Questionnaires were carefully examined for completeness upon receipt. Computerized facsimiles of the survey data were then prepared for each institution, comparing the current and 2 prior years' data and noting any substantive disparities. These facsimiles were mailed to the respondents so that they could provide revisions before final processing and tabulation of the data.

Respondents were asked to explain significant discrepancies between current and prior years' reporting patterns previously verified as correct (see Data Anomalies for more information). They were encouraged to correct prior years' data if anomalies were identified. When updated or amended figures covering past years were submitted, NSF correspondingly changed trend data. Similarly, if a respondent institution underwent an organizational change, such as a merger, NSF incorporated the effects of such changes into prior years' data.

By the survey closing date at the end of July, forms had been received from 483 universities and colleges out of the academic sample population of 493, resulting in a 98-percent response rate. Responses were received from 98.5 percent of all doctorate-granting institutions, where 97.5 percent of the estimated national R&D expenditures in S&E fields was disbursed. Also, forms were received from 17 of the 18 FFRDCs; the last one provided data via the telephone. Tables A-1a and A-1b display a detailed breakdown of the response rates by highest degree granted and by sampling stratum (defined later in this section under "Sampling, Weighting, and Standard Errors of the Estimates").

National Total and Imputation

To provide a national estimate for all universities and colleges performing R&D in FY 1997, it was necessary to implement three statistical procedures. First, data were estimated by "imputation" for the 2 percent of the sample population that had not responded by the closing date of the survey. Imputation has been used consistently since FY 1976. Second, data were also imputed for universities and colleges that submitted only partial responses. The imputed total, prior to weighting, was $76 million. Third, the sample total was weighted to compensate for those universities and colleges that were in the survey universe but not in the survey sample. (This procedure is described later under "Sampling, Weighting, and Standard Errors of the Estimates.") This process led to an estimate of $299 million in the national total of R&D expenditures at universities and colleges for FY 1997, resulting in a $24.348 billion total, as shown in table A-2. (The imputed total, adjusted for sample expansions, was $86 million, as noted in table A-2.)

Tables A-3a and A-3b present breakdowns of both the imputed amounts and the amount of the weighted inflator by broad S&E field. The dollar amount imputed is displayed along with the percentage it represents of the national estimate for universities and colleges in a particular field. The inflated amount due to sample weighting is also reported for each field. The amount imputed is similarly broken down by source of funds in table A-4.

A number of surveyed institutions have responded only intermittently in past years, providing data one year, not responding for one or more subsequent years, and then providing data again. For the years in which no response was received, data have been imputed as previously described. Although the imputation algorithm accurately reflects national trends, it cannot account for reporting anomalies at individual institutions. For this reason a separate backcasting of prior years' data was performed, following current-year imputation.

For each institution, formerly imputed key variables for items 1 to 3 were compared with subsequent submissions to determine whether the imputed data accurately represent the growth patterns shown by reported data. Re-estimation was applied when the imputed data were not consistent with reported data. If data were reported for fiscal years 1994 and 1997 but not for the intervening years, for example, the difference between the reported figures for each item total was calculated and evenly distributed across the intervening years (1995–96). The new figures were spread across disciplines (items 2 and 3) or sources of support (item 1) on the basis of the most recent reporting pattern. A clean facsimile was generated for each of the institutions undergoing these procedures and returned to the school for comment. These procedures resulted in much more consistent reporting trends for individual institutions but had little effect upon aggregate figures reflecting national totals.

Data Anomalies

Aggregate academic expenditure data are generally consistent from year to year, although data for individual institutions may vary considerably. Data anomalies may reflect true increases or decreases in expenditures or may be the result of changes in reporting methodology.

The following institutions provided revised data after the FY 1997 database was closed. Their revised data will be reflected in the FY 1998 tables.

- North Carolina State University provided revised FY 1996 academic R&D expenditures data. Their total science and engineering R&D expenditures increased from $190.748 million to $228.120 million as a result of an increase in their institutional funds.

- Oklahoma State provided FY 1997 revised data due to the omission of expenditures related to the Agricultural Experiment Station, which conducts organized research. Their total R&D expenditures increased from $38.649 million to $62.480 million.

- University of Massachusetts at Lowell provided revised FY 1996 and 1997 survey data. The FY 1996 total R&D expenditures did not change; the equipment dollars for minor subfields were changed. The FY 1997 total R&D expenditures increased from $18.328 million to $18.695 million as a result of an increase in their institutional funds.

In addition there were some institutions that revised their FY 1996 data before the closeout of the FY 1997 database. Two institutions with proportionately large revisions to their FY 1996 data were:

- University of Florida revised their FY 1996 data from $213 million to $255 million in their total science and engineering R&D;

- University of Hawaii Manoa revised the FY 1996 data from $73 million to $111 million in their total science and engineering R&D.

Other institutions provided explanations of interest for fluctuations in their data. For example:

- Tuskegee University reported that all large increases for FY 1997 were due to a large increase in grant activity.

Highest-Degree-Granted Tables

Several longitudinal tables display data for institutions whose highest S&E degree granted is at the doctoral level. In tables produced prior to FY 1992, it would have been difficult to identify whether changes in yearly R&D expenditures were caused by changes in expenditure levels or in the number of doctorate-granting institutions. In order to maintain a consistent group of institutions across all years, the highest-degree-granted status for each institution is based on the highest degree granted in the most recent year, FY 1997.

Sampling, Weighting, and Standard Errors of the Estimates

NSF conducts full population surveys every 5 years. During intervening years, a sample of institutions is drawn and surveyed. Only universities and colleges are included in the sampling frame; FFRDCs are always surveyed. Since a full population survey was conducted in FY 1993, a new sample of institutions was drawn for the FY 1994 survey. This sample was maintained and resurveyed in FY 1997; the next full population survey will be in FY 1998. Universities and colleges have been grouped into the following four sampling strata (three certainty strata and one probability stratum):

(1) A certainty stratum of doctorate-granting institutions. This stratum contains 310 universities and colleges that have doctoral programs in S&E. Excluded from this stratum are all doctorate-granting historically black colleges and universities (HBCUs) and university-system campuses.

(2) A certainty stratum of HBCUs. This stratum includes all 65 HBCUs (including those that are doctorate-granting institutions or university-system campuses).

(3) A certainty stratum of university-system campuses. This stratum includes 56 “university-system campuses”; each sample entry is the aggregation of all campuses that make up a university system. Note that no HBCUs are included in this stratum even if they are university-system campuses.

(4) A probability stratum of institutions that grant degrees at the master's level or below. This stratum includes 62 master's or bachelor's degree-granting institutions and institutions that offer no S&E degrees at any degree level, out of a survey stratum universe of 243. Note that none of the universities or colleges included in this stratum is either an HBCU or a university-system campus. This stratum had a sampling ratio of 26 percent.

The data in this report are weighted to represent national-level R&D expenditures for universities and colleges (as mentioned previously under "National Total and Imputation"). The sample data, after imputation, were inflated to produce universe estimates by weighting the individual questionnaire data values by the inverse of the sampling ratio. Thus, in aggregating data for institutions from the probability stratum for tabulation purposes, each datum value was weighted by the inverse of the sampling ratio.

Estimates derived for institutions in the probability stratum were based on a sample, and the relative standard error (coefficient of variation) of an estimate was then obtained by dividing the standard error by the estimate itself, expressed as a percentage of the estimate.

The standard errors and coefficients of variation for each major S&E field and subfields are shown in table A-5. For example, for total academic R&D expenditures of $24 billion, the standard error of the estimate is $173.2 million at the 95-percent confidence level, with a coefficient of variation of ±0.7 percent. Similarly, for the estimate of $14.5 billion in federally financed expenditures, the 95-percent confidence limits are ± $81.1 million, with a coefficient of variation of ±0.6 percent.

Data Availability

Data published in this report are also available in machine-readable form on the World Wide Web. Single-year or multi-year data files are available with data for FY 1975 through FY 1997. Information on file formats and the years for which they are available can be found on the World Wide Web at URL *http://www.nsf.gov/sbe/srs/rdexp/95pubuse.htm*.

Selected data items for institutions are available on the World Wide Web *(http://www.nsf.gov/sbe/srs/profiles/start.htm)*. These profiles cover data from this survey as well as data collected in NSF's other academic S&E surveys: the Survey of Graduate Students and Postdoctorates in Science and Engineering (graduate student survey) and the Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions (Federal support survey). The profiles are also linked to the corresponding ranking table of each survey.

Institutional researchers can obtain data from several academic S&E resources through the Web Computer-Aided Science Policy Analysis and Research (WebCASPAR) database system, which is an easy-to-use tool for the retrieval and analysis of statistical data on academic S&E resources. WebCASPAR provides an extensive and growing data library with multi-year statistics on the state of higher education in general and on academic S&E resources specifically. This data library is based on a set of standard institutional and field-of-science definitions across the multiple sources used to develop the database. The WebCASPAR program includes built-in help capabilities to facilitate the use and interpretation of the data.

The latest version of WebCASPAR can now be accessed via the World Wide Web *(http://caspar.nsf.gov/webcaspar)*.

WebCASPAR data are drawn from a number of sources. All data are available for individual institutions, by State, and at the national level. Longitudinal data from surveys of universities and colleges conducted by the NSF Division of Science Resources Studies include the academic R&D expenditures survey, the Federal support survey, and the graduate student survey. Data from the surveys of universities and colleges conducted by National Center for Education Statistics include earned degrees, opening fall enrollment, faculty salaries, tenure and fringe benefits, and financial statistics.

SECTION A.
TABLES

SECTION A. TABLES

Table A-1a. Response rates for the academic research and development expenditures survey, by highest degree granted: fiscal year 1997

Highest degree granted	Number in survey universe	Number in sample population	Number of complete responses	Number of partial responses	Total number of responses	Response rate
Grand total	692	511	371	130	501	98.0
Universities and colleges total	674	493	354	129	483	98.0
Doctorate	343	343	244	94	338	98.5
Master's	203	84	65	15	80	95.2
Bachelor's and below	128	66	45	20	65	98.5
Academically-administered FFRDCs total	18	18	17	1	18	100.0

SOURCE: National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997

Table A-1b. Response rates for the academic research and development expenditures survey, by stratum and highest degree granted: fiscal year 1997

Stratum	Number in survey universe	Number in sample population	Number of complete responses	Number of partial responses	Total number of responses	Response rate
Grand total	692	511	371	130	501	98.0
Doctoral stratum 1/	310	310	218	87	305	98.4
HBCU stratum	65	65	41	22	63	96.9
Doctorate	11	11	7	4	11	100.0
Master's	17	17	9	7	16	94.1
Bachelor's and below	37	37	25	11	36	97.3
University system stratum	56	56	48	8	56	100.0
Doctorate	22	22	19	3	22	100.0
Master's	29	29	25	4	29	100.0
Bachelor's and below	5	5	4	1	5	100.0
Master's or below stratum 2/	243	62	47	12	59	95.2
Master's	156	38	31	4	35	92.1
Bachelor's and below	87	24	16	8	24	100.0
Academically-administered FFRDCs	18	18	17	1	18	100.0

1/ Doctoral stratum does not include doctorate-granting institutions that are recorded in either the HBCU or the university system strata.

2/ Master's or below stratum does not include master's-granting institutions or bachelor's- and no-S&E-degree-granting - institutions that are recorded in either the HBCU stratum or the university system stratum.

SOURCE: National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997

Table A-2. Imputed amounts for total research and development expenditures at universities and colleges, by highest degree granted: fiscal year 1997

[Dollars in millions]

Highest degree granted	National estimate of separately budgeted R&D expenditures	Amount inflated due to weighting	Inflated imputed amount	Inflated imputed amount as percent of total
Total	24,348	299	86	0.4
Doctorate granting institutions	23,740	0	65	0.3
Non-doctorate granting institutions	608	299	21	3.4

SOURCE: National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997

Table A-3a. Imputed amounts for total research and development expenditures at universities and colleges, by science and engineering field: fiscal year 1997

[Dollars in millions]

Science and engineering field	National estimate of separately budgeted R&D expenditures	Amount inflated due to weighting	Inflated imputed amount*	Inflated imputed amount as percent of total
Total	24,348	299	86	0.4
Engineering	3,818	26	110	2.9
Physical sciences	2,364	33	56	2.4
Environmental sciences	1,539	44	66	4.3
Mathematical sciences	293	10	7	2.5
Computer sciences	718	16	34	4.8
Life sciences	13,608	124	233	1.7
Psychology	387	5	12	3.0
Social sciences	1,117	35	48	4.3
Other sciences	504	6	7	1.4

* The imputation rate at the total level is lower than imputation rates at the S&E field levels because many institutions could provide totals but not the S&E field details.

SOURCE: National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997

Table A-3b. Imputed amounts for federally financed research and development expenditures at universities and colleges, by science and engineering field: fiscal year 1997

[Dollars in millions]

Science and engineering field	National estimate of separately budgeted R&D expenditures	Amount inflated due to weighting	Inflated imputed amount*	Inflated imputed amount as percent of total
Total	14,502	153	70	0.5
Engineering	2,269	16	66	2.9
Physical sciences	1,705	20	36	2.1
Environmental sciences	1,034	23	41	4.0
Mathematical sciences	206	6	5	2.6
Computer sciences	514	11	26	5.1
Life sciences	7,881	52	132	1.7
Psychology	269	4	10	3.6
Social sciences	418	18	24	5.6
Other sciences	206	3	3	1.4

* The imputation rate at the total level is lower than imputation rates at the S&E field levels because many institutions could provide totals but not the S&E field details.

SOURCE: National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997

Table A-4. Imputed amounts for research and development expenditures at universities and colleges, by source of funds: fiscal year 1997

[Dollars in millions]

Source of funds	National estimate of separately budgeted R&D expenditures	Amount inflated due to weighting	Inflated imputed amount*	Inflated imputed amount as percent of total
Total	24,348	299	86	0.4
Federal Government	14,502	153	70	0.5
State and local government	1,877	24	32	1.7
Industry	1,713	17	14	0.8
Institutional funds	4,544	80	31	0.7
All other sources	1,712	26	6	0.4

* The imputation rate at the total level is lower than imputation rates at the S&E field levels because many institutions could provide totals but not the S&E field details.

SOURCE: National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997

Table A-5. Standard errors of the estimates (SE) and coefficients of variation (CV) for research and development expenditures at universities and colleges, by science and engineering fields: fiscal year 1997

[SE in thousands of dollars; CV in percent]

Science and engineering field	Total R&D expenditures		Federally financed R&D expenditures	
	1.96 SE	1.96 CV	1.96 SE	1.96 CV
Total	173,162	0.7	81,129	0.6
Engineering (Total)	19,402	0.5	13,815	0.6
Aeronautical & Astronautical	2,791	1.1	1,785	1.0
Chemical	1,004	0.3	457	0.3
Civil	2,239	0.5	1,195	0.6
Electrical	5,146	0.5	4,446	0.7
Mechanical	9,427	1.8	7,738	2.4
Metallurgical and Materials	447	0.1	349	0.2
Other, n.e.c.	4,875	0.5	1,571	0.3
Physical sciences (Total)	16,096	0.7	10,294	0.6
Astronomy	1,581	0.5	782	0.4
Chemistry	9,615	1.2	7,174	1.3
Physics	5,791	0.6	3,237	0.4
Other, n.e.c.	1,530	0.7	644	0.4
Environmental sciences (Total)	37,060	2.4	21,388	2.1
Atmospheric Sciences	2,966	1.3	2,940	1.6
Earth Sciences	14,612	3.2	6,660	2.5
Oceanography	34,061	6.2	20,206	5.4
Other, n.e.c.	2,418	0.8	344	0.2
Mathematical sciences	5,652	1.9	3,851	1.9
Computer sciences	12,924	1.8	9,647	1.9
Life sciences (Total)	112,384	0.8	32,800	0.4
Agricultural Sciences	26,297	1.3	9,004	1.6
Biological Sciences	86,773	2.1	26,997	1.0
Medical Sciences	6,595	0.1	3,867	0.1
Other, n.e.c.	1,443	0.3	953	0.3
Psychology	2,559	0.7	2,291	0.9
Social sciences (Total)	26,519	2.4	16,589	4.0
Economics	2,380	1.0	1,974	2.2
Political Science	3,120	1.8	937	1.8
Sociology	6,567	2.6	4,154	3.5
Other, n.e.c.	24,855	5.7	15,278	9.8
Other sciences, n.e.c.	4,542	0.9	3,647	1.8

SOURCE: National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997